I Claim:

1. A hybrid blade wind turbine apparatus, comprising:

a helically twisted blade supported for rotation about an axis;

a plurality of substantially straight airfoil blades fixed with the helically twisted blade and supported for rotation about the axis; and

a turbine mast having a longitudinal axis of rotation and rotatably supporting the helically twisted blade and the plurality of airfoil blades, wherein each of the helically twisted blades and the airfoil blades cooperates in wind conditions to drive the operation of the other of the helically twisted blades and the airfoil blades.

2. The apparatus of claim 1, wherein the helically twisted blade is provided with air drag reduction means formed as radially segmented helical blades.

3. The apparatus of claim 1, wherein the airfoil blades are longer than the helically twisted blade.

4. The apparatus of claim 1, wherein the helically twisted blade and airfoil blades are mounted for rotation within a protective safety cage.

5. The apparatus of claim 4, wherein the protective safety cage rotatably supports the helically twisted blade, the plurality of airfoil blades and the turbine mast.

6. The apparatus of claim 5, wherein the protective safety cage is formed of one of a metal wire mesh, a plastic wire mesh, and combinations thereof.

7. The apparatus of claim 1, wherein the helically twisted blade comprises two helical half wing blades.

8. The apparatus of claim 7, wherein the respective vane segments are formed of one of fiber glass sheeting, polycarbonate, polyvinyl chloride, aluminum, light steel sheeting, Kevlar, polyurethane, and rubber sheeting material.

9. The apparatus of claim 7, wherein the material used for the vane segments is treated to be UV-light resistive.

10. The apparatus of claim 7, wherein each helical half wing blade is formed of a plurality of elongated vane segments.

11. The apparatus of claim 10, wherein each helical half wing blade is formed of between 2 to 9 separate elongated vane segments.

12. The apparatus of claim 11, wherein, for use in applications of one of elevated height, elevated wind speed, and a combination thereof, each helical half wing blade is formed of between 5 and 9 vane segments.

13. The apparatus of claim 11, wherein, for use in applications of one of reduced height, reduced wind speed and a combination thereof, each helical half wing blade is formed of between 2 and 6 vane segments.

14. The apparatus of claim 7, wherein each helical half wing blade is substantially smooth-walled and formed of multiple edge-abutting vane components mounted to a transverse support struts carried by the turbine mast.

15. The apparatus of claim 14, wherein each elongated vane segment has a width in the range of approximately 3 to 11 inches.

16. The apparatus of claim 15, wherein each elongated vane segment has a width of approximately 11 inches.

17. The apparatus of claim 14, wherein each elongated vane segment has a thickness in the range of approximately 0.03 to 0.25 inches.

18. The apparatus of claim 17, wherein each elongated vane segment has a thickness of approximately .2 inches.

19. The apparatus of claim 1, wherein the helically twisted blade is formed of flexible elongated vane segments.

20. The apparatus of claim 19, wherein the respective vane segments are formed of one of fiber glass sheeting, polycarbonate, polyvinyl chloride, aluminum, light steel sheeting, Kevlar, polyurethane, and rubber sheeting material.

21. The apparatus of claim 19, wherein the material used for the vane segments is treated to be UV-light degradation inhibited.

22. The apparatus of claim 19, wherein each vane segment has a fixed edge and a free edge, and the free edge of one vane segment one of at least partially overlaps, and substantially abuts the fixed edge of the next adjacent vane segment.

23. The apparatus of claim 22, wherein the amount of overlap of the free edge of one vane segment over the fixed edge of the next adjacent vane segment is a distance in the range of from approximately 0 to 2 inches.

24. The apparatus of claim 22, wherein, during rotational operation, the free edge of each vane segment is adapted to rise up from the fixed edge of the next adjacent vane segment by a separation distance creating separation air slots between respective vane segments.

25. The apparatus of claim 24, wherein the separation distance is in the range of between approximately 1/8 to 3/4 inch.

26. The apparatus of claim 24, wherein, during rotational operation, the separation distance created between the radially-outermost mounted vane segments is greater than the separation distance created between the radially-innermost mounted vane segments.

27. The apparatus of claim 22, wherein an aerodynamically-shaped vane nose bracket mounts the fixed edge of each vane segment.

28. The apparatus of claim 22, wherein the vane segments are made from a flexible material wherein, during rotational operation, the respective free edges of the vane segments are able to rise up away from the fixed edges of the adjacent vane segments to provide air flow slots therebetween.

29. The apparatus of claim 19, wherein each vane segment is separated from the next adjacent vane segment by a separation distance creating separation air slots between respective vane segments.

30. The apparatus of claim 1, wherein the turbine mast is mounted substantially vertically.

31. The apparatus of claim 1, and wherein the overall outer shape of the wind turbine apparatus is one of substantially cylindrical, conical, frustro-conical, and combinations thereof.

32. The apparatus of claim 1, and an energy converting device driven by the turbine mast for converting rotational energy into electrical energy.

33. The apparatus of claim 32, and wherein the energy converting device is one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

34. The apparatus of claim 32, and wherein the energy converting device comprises a pressurized air system, including an air motor, an air storage container, and a pressurized air motor-to-electric generator.

35. The apparatus of claim 1, and wherein the helically twisted blade is twisted, from one end to the other end, though a twist rotation of one of approximately 45°, 90°, 180°, and 270°.

36. The apparatus of claim 1, and a protective safety enclosure mounted about the helically twisted blade and airfoil blades.

37. The apparatus of claim 36, and wherein the protective safety enclosure is formed as a support frame carrying a protective wire mesh.

38. The apparatus of claim 37, wherein the support frame has a support ring member at each end, each support ring member having a central journal hub for rotatably supporting an end of the turbine mast.

39. The apparatus of claim 38, and wherein the support frame also has at least one central support ring.

40. The apparatus of claim 38, wherein each support ring member has support struts connecting to a central hub, and at least one support ring and connecting struts are formed to have an inwardly conical shape to permit mounting of an energy conversion device.

41. The apparatus of claim 37, wherein the support frame is formed of one of tubular metal members, tubular plastic members, and combinations thereof.

42. The apparatus of claim 41, wherein the support frame is formed of tubular galvanized steel.

43. The apparatus of claim 37, and a support stand carrying the support frame, and wherein the support frame is adapted to support the turbine mast in one of substantially horizontal, vertical, and angular operational positions.

44. The apparatus of claim 1, wherein the specification for the shape and design of each of the respective airfoil blades is one of NACA 0015 and NACA 0012.

45. The apparatus of claim 1, wherein the length of airfoil blades is within range of between substantially 105% to 150% the length of the helically twisted blade.

46. The apparatus of claim 45, wherein the length of airfoil blades is substantially 120% the length of the helically twisted blade.

47. The apparatus of claim 1, and a plurality of transverse blade support struts connecting the helically twisted blade to the turbine mast.

48. The apparatus of claim 47, wherein the helically twisted blade is formed of elongated vane segments.

49. The apparatus of claim 48, wherein the respective edges of each vane segment substantially abuts the edge of the next adjacent vane segment.

50. The apparatus of claim 48, wherein each respective edge of a vane segment is a fixed edge.

51. The apparatus of claim 48, wherein each vane segment has a fixed edge and a free edge, and each free edge one of substantially abuts and overlaps the fixed edge of the adjacent vane segment.

52. The apparatus of claim 51, wherein during rotational operation, the free edges of the flexible vane segments are adapted to raise up from and lower against the fixed edge of the adjacent vane segment in response to air pressure thereagainst, thereby maximizing rotational torque and minimizing rotational resistance of the helically twisted blade as its helical blade surfaces are respectively presented in windward and leeward conditions.

53. The apparatus of claim 48, wherein each vane segment is separated from the next adjacent vane segment by a separation distance creating separation air slots between respective vane segments.

54. The apparatus of claim 1, wherein, for use in applications at heights of substantially 500 feet and lower, the respective airfoil blades comprise a low speed NACA airfoil shape.

55. The apparatus of claim 1, wherein, for use in applications at heights of substantially 500 feet and above, the respective airfoil blades comprise a high speed NACA airfoil shape.

56. The apparatus of claim 1, wherein in cross section the shape of each of the respective airfoil blades is symmetrical.

57. The apparatus of claim 1, wherein the overall diameter for the respective airfoil blades as mounted to the turbine mast is in the range of between approximately 36 inches to 74 inches.

58. The apparatus of claim 57, and wherein the diameter used for mounting the airfoil blades on the turbine mast for use in elevated height wind speed applications is less than the diameter used for mounting the airfoil blades for use in reduced height wind speed applications.

59. The apparatus of claim 1, wherein the helically twisted blade and the airfoil blades cooperatively limits the operational rotation at no greater than 3 ½ wing tip speed versus wind speed.

60. The apparatus of claim 1, and wherein the hybrid blade wind turbine has a turbine aspect ratio, by comparison of the overall turbine width to the overall turbine blade length, in the range of from approximately 1:3 to 3:5.

61. The apparatus of claim 1, wherein the diameter of the innermost edge of the outer airfoil blades is in the range of approximately 4 to 24 inches greater than the outer diameter of the inner helically twisted blade.

62. The apparatus of claim 1, wherein the length of the turbine mast is in the range from approximately 8 to 10 feet.

63. The apparatus of claim 1, wherein the helically twisted blade has a thickness in the range of between approximately 0.03 to .25 inches.

64. The apparatus of claim 1, wherein each helical blade segment has a width in the range from approximately 3 to 11 inches.

65. The apparatus of claim 1, wherein each helical blade segment has a length when twisted in the range of from approximately 6 to 9 feet.

66. The apparatus of claim 1, wherein each airfoil blade has a length in the range from approximately 9.5 to 11.5 feet.

67. The apparatus of claim 1, wherein the diameter of the helically twisted blade is in the range from approximately 24 to 50 inches.

68. The apparatus of claim 1, wherein the airfoil blades are formed of one of extruded aluminum, an aluminum sheet construction over foam, molded or extruded plastic polycarbonate, molded or extruded plastic polyvinyl chloride, molded or extruded PVC, and combinations thereof.

69. The apparatus of claim 1, wherein the cross-sectional thickness of each respective airfoil blade is in the range from approximately 0.5 inch to 1.5 inch.

70. The apparatus of claim 1, wherein the helically twisted blade has a twist rotation, from end-to-end, of between approximately 45° and 270°.

71. The apparatus of claim 1, wherein the turbine mast comprises a first mast section, and a second non-contiguous mast section, wherein the first and second mast sections cooperate to support the helically twisted blade and the plurality of airfoil blades, and wherein the first and second mast sections are rotatably supported about the longitudinal axis of rotation.

72. A hybrid blade wind turbine system comprising a plurality of turbine apparatuses as defined in claim 1, said turbine apparatuses being interconnected to form a network of turbine apparatuses.

73. The hybrid blade wind turbine system as defined in claim 72, wherein each of the turbine apparatuses are rotatably supported for individual rotation.

74. A method of achieving maximized wind harvesting for generating electrical power, comprising the steps of:

providing a rotatably supported helically twisted blade with a plurality of flexible elongated vane segments, wherein each vane segment has a fixed edge and a free edge, and the free edge of one segment one of at least partially overlaps and substantially abuts the fixed edge of the next adjacent vane segment; and

creating separation air slots between the elongated vane segments by allowing the free edge of at least one vane segment to rise up from the fixed edge of the next adjacent vane segment during rotation of the rotatably supported helically twisted blade,

wherein, when operating at high rotational speeds, the respective separation air slots created between vane segments of the helically twisted blade operate as an air brake to help prevent runaway rotational conditions.

75. The method of claim 74, wherein the free edge of each vane segment overlaps the fixed edge of the next adjacent vane segment by a distance in the range from approximately 0 to 2 inches.

76. The method of claim 74, wherein during rotational operation, the free edge of each vane segment is adapted to rise up from the fixed edge of the next adjacent vane segment by a separation distance in the range of between approximately 1/8" to 3/4".

77. The method of claim 74, wherein during rotational operation, the separation distance between the radially-outermost mounted vane segments is greater than the separation distance between the radially-innermost mounted vane segments.

78. The method of claim 74, further comprising the step of mounting each of the vane segments within an aerodynamically-shaped vane nose bracket.

79. The method of claim 74, further comprising the step of mounting the helically twisted blade to a substantially vertically aligned rotatable turbine mast.

80. The method of claim 74, wherein the helically twisted blade is rotatably supported within a protective safety cage.

81. The method of claim 74, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade into electrical energy.

82. The method of claim 74, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade into electrical energy utilizing one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

83. The method of claim 74, wherein the helically twisted blade is twisted from one end to the other end, through a twist rotation of one of approximately 45°, 90°, 180°, and 270°.

84. The method of claim 74, further comprising the step of mounting a plurality of substantially straight airfoil blades fixed for rotation with the helically twisted blade and rotatably supported therewith.

85. The method of claim 84, wherein the airfoil blades are longer than the helically twisted blade.

86. The method of claim 84, wherein the helically twisted blade and airfoil blades are rotatably supported within a protective safety cage.

87. The method of claim 84, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade and airfoil blades into electrical energy.

88. The method of claim 87, wherein the converting step comprises utilizing one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

89. The method of claim 84, wherein the helically twisted blade is twisted from one end to the other end, through a twist rotation of one of approximately 45°, 90°, 180°, and 270°.

90. A method of overcoming blade profile differentiation in a helical wind turbine blade having a windward side and a leeward side, comprising the steps of:

forming a rotatably supported helically twisted blade to comprise a plurality of flexible elongated vane segments, wherein each vane segment has a fixed edge and a free edge, and the free edge of one segment at least one of partially overlaps and substantially abuts the fixed edge of the next adjacent vane segment; and

raising the free edge of at least one vane segment up from the fixed edge of the next adjacent vane segment during rotation of the rotatably supported helically twisted blade, thereby providing an air valve opening to reduce air drag when the leeward side surfaces of the helically twisted blade are being periodically presented against the wind.

91. The method of claim 90, wherein during rotation, the free edge of each vane segment is adapted to rise up from the fixed edge of the next adjacent vane segment by a variable separation distance in the range of between approximately 1/8" to 3/4".

92. The method of claim 91, wherein during rotational operation, the variable separation distance between the radially-outermost mounted vane segments is greater than the variable separation distance between the radially-innermost mounted vane segments.

93. The method of claim 90, further comprising the step of mounting the helically twisted blade to a substantially vertically aligned rotatable turbine mast.

94. The method of claim 90, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade into electrical energy.

95. The method of claim 94, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade into electrical energy utilizing one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

96. The method of claim 90, wherein the helically twisted blade is twisted from one end to the other end, through a twist rotation of one of approximately 45°, 90°, 180°, and 270°.

97. The method of claim 90, further comprising the step of mounting a plurality of substantially straight airfoil blades fixed for rotation with the helically twisted blade and rotatably supported therewith.

98. The method of claim 97, wherein the airfoil blades are longer than the helically twisted blade.

99. The method of claim 97, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade and airfoil blades into electrical energy.

100. The method of claim 97, wherein the converting step comprises utilizing one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

101. The method of claim 97, wherein the helically twisted blade is twisted from one end to the other end, through a twist rotation of one of approximately 45°, 90°, 180°, and 270°.

102. The method of claim 90, further comprising the steps of lowering the free edges of the respective vane segments towards the respective fixed edges of adjacent vane segments when the leeward side is in position of taking in air, and raising the free edges up from adjacent fixed edges of adjacent vane segments as an air valve when the windward side is in position of being forced against wind, thereby creating reduced air drag by letting air flow from the leeward side through the separation air slots as formed between the respective raised free edges and fixed edges of the vane segments.

103. A wind turbine apparatus for harvesting wind energy, comprising:
a helical blade journaled for rotation;

the helical blade being separated into a plurality of lengthwise blade segments, each blade segment having a radially inward fixed edge, and a radially outward free edge, the respective free edges being adapted, during wind turbine operation, to rise up through a separation distance away from the respective fixed edges, the free edges thereby moving from a normal rest position to a full operating position.

104. The apparatus of claim 102, further comprising a turbine mast journaled for rotation and wherein the helical blade is carried by the turbine mast;

105. The apparatus of claim 102, wherein the free edge of a given blade segment radially overlaps the fixed edge of the next adjacent blade segment.

106. The apparatus of claim 102, and an aerodynamically shaped nose element mounted on the fixed edge of the respective blade segments so as to help reduce air drag.

107. The apparatus of claim 102, and at least a pair of airfoil blades fixed with and located radially outward of the helical blade.

108. The apparatus of claim 107, wherein the overall length of the airfoil blades is in the range of approximately 105% to 150% of the overall length of the helical blade.

109. The apparatus of claim 107, wherein two airfoil blades are carried by the turbine mast at diametrically opposed positions.

110. The apparatus of claim 107, wherein a plurality of airfoil blades are carried by the turbine mast at circumferentially symmetrical positions.

111. The apparatus of claim 107, wherein the airfoil blades are substantially straight.

112. The apparatus of claim 107, wherein the airfoil blades are radially positionally adjustable relative to the helical blade, to thereby help maximize wind harvesting depending upon the local wind conditions and the mounting height of the wind turbine apparatus.

113. The apparatus of claim 107, and a protective cage enclosing the helical blade and airfoil blades.

114. The apparatus of claim 102, wherein the helical blade is mounted in one of substantially horizontal, vertical, and angular alignment.

115. A wind turbine apparatus having a hybrid turbine blade assembly operating on a common axis, comprising, a helically twisted blade a rotationally journaled about an axis, and substantially straight airfoil blades mounted radially outwardly of the helically twisted blade.

116. The wind turbine of claim 115, further comprising a rotationally journaled turbine mast adapted to support the hybrid turbine blade assembly.

117. The wind turbine of claim 115, and wherein the substantially straight airfoil blades are respectively mounted at diametrically opposed locations about the helically twisted blade.

118. The wind turbine of claim 115, wherein the helically twisted blade comprises a plurality of elongated helical blade segments each having a radially inward fixed edge and a radially outward free edge.

119. The wind turbine of claim 115, and wherein the helically twisted blade comprises a pair of helical half blades.

120. The wind turbine of claim 119, wherein each helical half blade is formed of elongated vane segments, each vane segment having a free edge operable, during rotation, to lift away from the next outwardly adjacent vane segment.

121. The wind turbine of claim 120, wherein the free edge of a respective blade segment overlaps the fixed edge of the next radially outward blade segment.

122. The wind turbine of claim 115, wherein the airfoil blades are longer than the helically twisted blade.

123. A method of maximizing wind energy harvesting by a wind turbine while minimizing air drag and over-speed conditions, comprising the steps of:

mounting a helically twisted blade supported for rotation;

mounting a plurality of substantially straight airfoil blades for rotation, wherein the substantially straight airfoil blades are mounted radially outwardly of the helically twisted blade and rotate with the helically twisted blade;

wherein the helically twisted blade is adapted to operate in low wind speed conditions to start the rotation of the airfoil blades,

wherein the airfoil blades and the helically twisted blade cooperate in mid-range wind speed conditions to rotate both the airfoil blades and the helically twisted blade,

and wherein the helically twisted blade is adapted to operate in high speed conditions to produce an air drag to prevent the over-speed rotation of the airfoil blades and the helically twisted blade.

124. The method of claim 123, wherein the helically twisted blade comprises a plurality of flexible elongated vane segments, wherein each vane segment has a fixed edge and a free edge, and wherein in low speed conditions the free edge of at least one vane segment at least one of partially overlaps and substantially abuts the fixed edge of the next adjacent vane segment, to thereby assist in starting the rotation of the airfoil blades.

125. The method of claim 124, wherein in mid-range wind speed conditions the free edge of at least one vane segment variably raises away from the fixed edge of the next adjacent vane segment thereby providing an air valve opening to reduce air drag when the leeward side surfaces of the helically twisted blade are being periodically presented against the wind.

126. The method of claim 124, wherein in high speed conditions the free edge of at least one vane segment raises away from the fixed edge of the next adjacent vane segment thereby providing air drag to help prevent the over-speed rotation of the airfoil blades.

127. The method of claim 124, wherein during rotation, the free edge of each vane segment is adapted to rise up from the fixed edge of the next adjacent vane segment by a variable separation distance in the range of between approximately 1/8" to 3/4".

128. The method of claim 124, wherein during rotational operation, the variable separation distance between the radially-outermost mounted vane segments is greater than the variable separation distance between the radially-innermost mounted vane segments.

129. The method of claim 123, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade and airfoil blade into electrical energy.

130. The method of claim 129, further comprising the step of converting rotational energy of the rotatably supported helically twisted blade into electrical energy utilizing one of a direct drive permanent magnet alternator, a belt drive permanent magnet alternator, a direct drive generator, a belt drive generator, a direct drive air motor and a belt drive air motor.

131. The method of claim 123, wherein the helically twisted blade is twisted from one end to the other end, through a twist rotation of one of approximately 45°, 90°, 180°, and 270°.